Roll No. .....

Total No. of Questions : 9
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UG (CBCS) IIIrd Year Annual Examination - 2025

B.Sc. PHYSICS
(Elements of Modern Physics)
(DSE-1A)

Paper : PHYS 301 TH
Time : 3 Hours] [Maximum Marks : 50

Note :— Attempt five questions in all, selecting one question each from Sections-B, C, D and E. Question No. 1 (Section-A) is compulsory.

Section-A

(Compulsory Question)

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1. (a) What is the basic difference between Photoelectric Effect and Compton's effect?

(b) What is fine structure? What is its cause?

(c) Differentiate between φ and $|\psi|^2$.

(d) What are mirror nuclei? Give example.

(e) What is meant by electron capture?

(f) What is a moderator in a nuclear reactor?

(g) Give definition of nuclear fission and fusion. **[2×7=14]**

Section-B

2. What is Compton's Effect? Can we observe Compton shift with visible light? Derive an expression for the wavelength of scattered photon in Compton effect. **[2,2,5]**

3. Explain Rutherford's Scattering experiment in detail. What are different postulates of Rutherford model of atom? What was the problem with Rutherford atomic model? **[4,3,2]**

Section-C

4. (a) Derive an expression for Heisenberg Energy time uncertainty principle. **[4,3,2]**

(b) Electron cannot exist inside the nucleus. Explain.

(c) What is wave-particle duality?

5. (a) Derive time-dependent Schrödinger's wave-equation. **[5,4]**

(b) Derive time-independent Schrödinger's wave-equation.

Section-D

6. Set-up Schrödinger's wave-equation for a particle in an infinite potential well : **[7,2]**

$$V(x) = 0, \quad \text{for } 0 < x < L$$
$$\infty, \quad \text{elsewhere}$$

and solve it for its wave function and energy.

How do the results differ from those of classical considerations?

7. What are the postulates of Liquid Drop Model? Derive an expression for Binding energy of Semi-empirical mass formula. **[3,6]**

Section-E

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8. (a) Deduce an expression for half-life of a radioactive substance. **[5,4]**

(b) What is mean-life of radioactive substance? How is it related with half-life?

9. Explain : **[3,3,3]**

(a) Mass Defect

(b) Binding Energy

(c) Thermal Neutrons